

Calorimeter Agenda

Introduction - *Kelley*

Progress Reports:

- NTD progress microcalorimeters - *Silver* 10 min
- TES progress microcalorimeters at Goddard - *Kilbourne* 10 min
- TES/MUX progress at NIST - *Irwin* 10 min

Special Topics:

- Prospects for very large arrays - *Figueroa/Irwin* 15 min
- Lessons learned for Con-X field of view - *Mushotzky* 15 min

Priorities in Changing Landscape

Concentrated on important activities for which we have existing personnel and laboratory resources.

- energy resolution
- array fabrication
- detector speed
- yield and reliability
- uniformity across the array
- acceptable thermal crosstalk
- acceptable electrical crosstalk
- effective heat sinking, especially of inner pixels
- mechanical robustness
- ease of integration
- multiplexing issues

Development Path Over Last Year

Reference Con-X Design: 250 micron pixels, 32 x 32 pixel array

- Focus on making arrays (including 8 x 8) and studying single pixel performance on limited numbers of channels.
- Pixel Characterization and Optimization
- *Breakthrough spectral resolution*
- Small MUX demonstrations

Thinking about dealing with higher count rates larger fields of view

Longer Focal Length Issues for XMS

Array Size vs. FOV and Focal Length

	2.5 arcmin	5.0 arcmin	10.0 arcmin
10 m f/l	0.7 cm	1.5 cm	2.9 cm
50 m f/l	3.6 cm	7.3 cm	14.5 cm

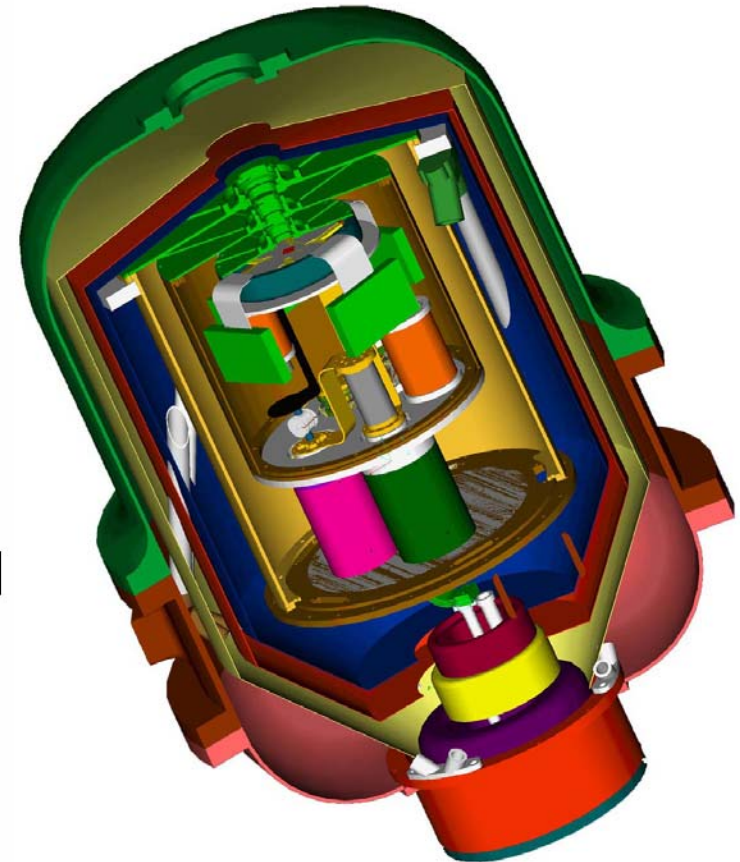
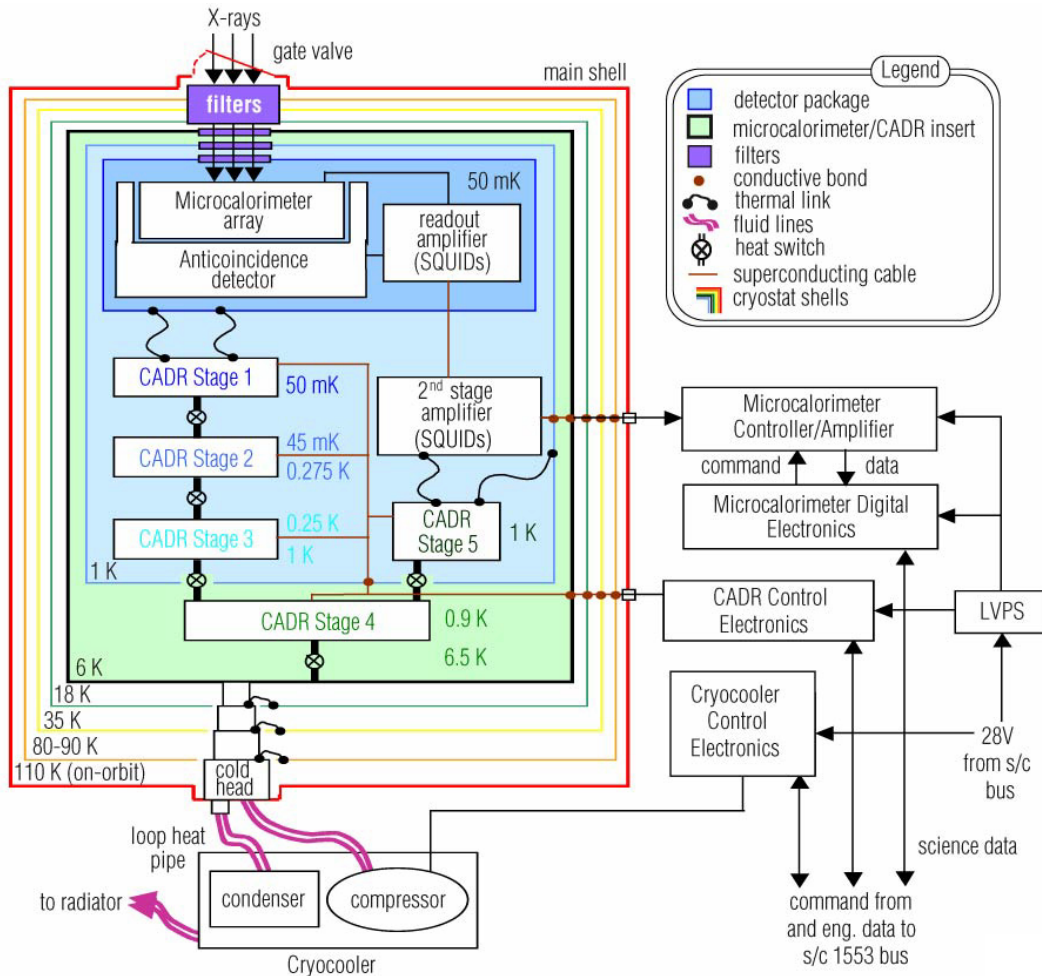
More channels \Rightarrow higher heat loads on ADR, etc.

Larger detector assembly \Rightarrow larger suspended cold stage

Larger aperture \Rightarrow larger (cold) blocking filters.

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Instrument Block Diagram and Conceptual Implementation



Size ~ 50 x 75 cm

Mass ~ 150 kg, including electronics

Microcalorimeter Technology Roadmap

Element	State-of-the-Art	Array TRL 4	Readout TRL 4	TRL 5	TRL 6	Flight Requirement
Array Size	32	5 x 5	24 pixels on 4 chips	8 x 8	32 x 32	32 x 32
Channels read out simultaneously	32	2	24	16	96	1024
Fabrication				Reliable superconducting leads, parasitic R < 5% of normal R	High-density interconnects	
MUX Scale	None	None	2 x 12	2 x 8	3 x 32 goal	32 x 32 goal
MUX Speed	None	None	5 MHz	10 MHz	20 MHz	20 MHz
Pixel Size	0.64 mm	0.25 mm	0.4 mm	0.25 mm	0.25 mm	0.25 mm
System Noise				< 2 eV	< 1 eV	< 1 eV
Energy Resolution	4.8 eV @ 6 keV	10 eV @ 6 keV			4 eV @ 6 keV	
Testing					Radiation, Environmental	
Time frame	XRS	Q1 of FY03	Q1 of FY03	Q4 of FY04	Q4 of FY05	
Technology gates				♦	♦	

CADR Technology Roadmap (unchanged from TRIP)

Element	TRL 3	TRL 4	TRL 5	TRL 6	Flight Baseline
Number of stages	3	4	4	5	5
Heat rejection temperature	1.3 K	4.2 K	6 K	6 K	6 K
Operating temperatures	60 mK	50 mK	50 mK	50 mK/1-4 K	50 mK/1-4 K
Cooling power at 50 mK		6 μ W	> 6 μ W	> 6 μ W	5 μ W
Cooling power of "1K" stage				> 0.3 mW at 1 K	0.23 mW
Temperature stability		8 μ K rms @ 100 mK (f<1 Hz)	8 μ K rms @ 50 mK (f<1 Hz)	2 μ K rms @ 50 mK (f<1 Hz)	2 μ K rms @ 50 mK (f>1 Hz)
Technology goal		High-temperature refrigerants	6+ K magnets	Flight electronics	
Testing				Env. Testing, XMS-level testing	
Time frame	FY01	FY02	Q4 of FY05	Q3 of FY06	
Technology Gates			u		

Cryocooler Roadmap

Element	State-of-the-Art	TRL 4	TRL 5	TRL 6	Flight Baseline
Compressor power	120 W	Similar design operating at 240 W	EM at 200 W		200 W
Pulse tube cold head	1 W at 57 K	Multi-stage lab test w/GSE compressor 20 mW at 6 K	EM w/GSE compressor		20 mW at 6 K 150 mW at 18 K
Control and drive electronics		Brassboard of ripple suppression	Single-box control, power, and ripple suppression		
Testing			Component vibe testing, System functional and TV testing	System level EMI test	
Time frame	TES & AIRS flight coolers	FY02	Q3 of FY05	Q3 of FY06	
Technology Gates			u		